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Estimate Freight Flows with Secondary Data: A Study in Belo Horizonte City, Brazil

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Introduction

Freight transportation is of paramount importance for the efficient and sustainable operation of different systems in urban areas. Moreover, in Brazil, the requirements and the complexity of the sector are not well understood and the management of the systems and operations can be fully transferred to the shipper. Hence, due to the private sector being unable to properly manage its operations, we usually experience lack of information and/or data unreliability which makes it difficult to estimate the impacts of policy changes in the context of transport planning. The complexity in modeling demand for freight transport arises from the need to consider the different dimensions (i.e. types of cargo, volumes and weights).

In this context and considering the usual scenario of low data availability in Brazil as well as the urgent need to improve current practices in the country, this paper aims to estimate freight flow in urban areas using secondary data. The findings indicates the importance of acquiring reliable information for policy making in the context of city logistics and the main challenges to implement a holistic and efficient freight planning in Brazil.

Urban Freight Transport Demand Modelling

City logistics is the process for totally optimizing the logistics and transport activities by private companies with the support of advanced information systems in urban areas considering the traffic environment, its congestion, safety and energy savings within the framework of a market economy. Other authors reinforce the need of finding solutions capable to simulate the effects of policies / measures before their implementation, in the framework of an ex-ante assessment, by stimulating the investigation of demand models to estimate freight Origin-Destination (O-D) flows.

Historically, Ogden¹⁾ is among the first researchers to dedicate to the topic. In his initial study, he proposed models to manage and control urban freight movements. Regan and Garrido²⁾ presented a summary of research in freight demand modeling and carrier behavior. Ambrosinie and Routhier³⁾ undergone an international comparative study between the methods developed and results obtained on freight

movement modeling.

Russo and Comi⁴⁾ conducted a study to identify the various decision makers involved in urban freight movement. The study have shown that the urban scale models can be divided into two levels: i) models that estimate the demand for type of freight using socioeconomic data, and ii) models that determine the service, time and vehicle use as well as the routes chosen. Both models use probability base approaches on the utilities consumption patterns in each zone.

Estimating Freight Flows

The proposed methodology was applied in the city of Belo Horizonte (Brazil). It is the capital of Minas Gerais State and the metropolitan area comprises an area of 331 km² where about 2.4 million people live. The study area was chosen considering various factors, being the main one data availability that would allow assessing the results of the proposed model and verify its validity in the context given in the past section.

The zoning was firstly obtained by aggregating neighborhoods defined according to administrative boundaries for the nine municipalities included in the metropolitan area of Belo Horizonte. In total, 30 zones and 12 in metropolitan areas were chosen for the case study. Furthermore, the food and beverage sector was selected for study, since it represents 42% of all freight vehicles in the central region of Belo Horizonte¹⁶⁾.

The database obtained was original from the Municipal Taxpayers' Registry provided by the Belo Horizonte City Council. The Municipal Taxpayers' Registry of Securities Taxes is the register of legal entities engaged in any economic activities in the city of Belo Horizonte.

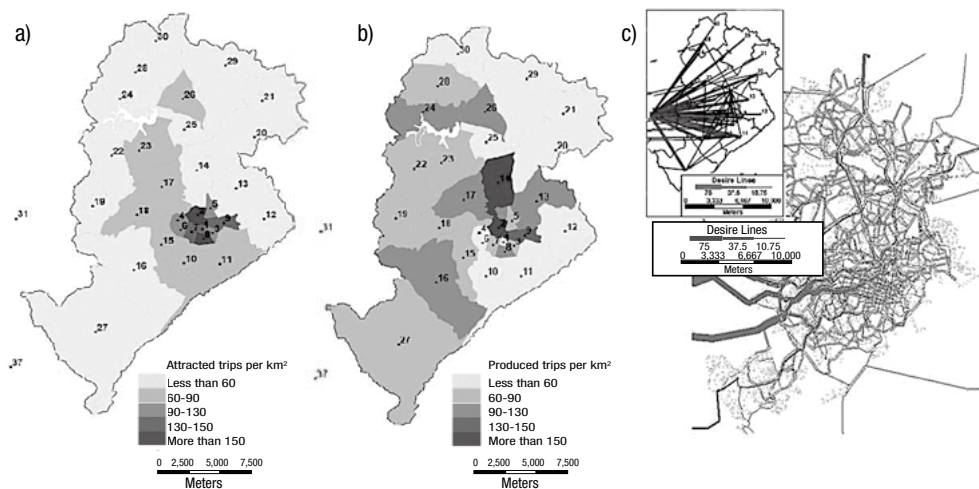
For the trip generation, were adopted models previously studied and recognized in the scientific community, whose boundary conditions are more similar to the conditions of the research (Melo (2002)⁵⁾ and Tadi and Balbach (1994)⁶⁾).

As a result of the trip generation model, the concentration of travel produced and attracted were analyzed. It is observed that the areas that attract trips, proportionately, are located in the central city, which is justifiable due to the great number of businesses in this area, Figure 1 a) and b).

Following trip generation, the trip distribution step was conducted making use of the TRANUS software. The given software proceeds with trip distribution using the Maximum Entropy method which suits very well for the present research. For the purpose of modeling, results from Oliveira⁷⁾ were used to estimate trip production for other municipalities in the metropolitan region.

The results achieved, Figure 1 c), proved the practical application of the proposed methodology in the Brazilian context. It must be highlighted that in the general context of data availability and policy making in Brazil the present research can be of great support for both government associates and private sector. For instance, a common practice adopted by the government is to make decisions on freight transport solely on anecdotal observations, which often generate more problems than solutions to urban movements.

Figure 1 a) Trips attracted per unit area
b) Trips produced per unit area
c) Desire Lines and freight distribution of food and beverage sectors in Belo Horizonte



Conclusion

The proposed methodology is based on identifying the main freight flows from public databases, available in Brazil. Treatment of the database allows to classify the business establishment in production establishments (travel generators) and consumption establishments (travel attractors), from the description of its activity.

The proposed methodology provides urban freight players with a systematic approach to collect / gather data, process results, represent information and support decision-making. The method is of further support as it has spatial components and links both data and results to the existing road network in the study area. Its potentiality is confirmed when it is noted that the city of Belo Horizonte has no current information on the volume and traffic regarding urban freight. Hence, the development and improvement of this (and similar) methodologies will surely improve the decision-making in policy making as well as contribute to a better and more sustainable operations.

An important issue regards to the reliability of data utilized. In the sectors studied, food and beverages, distortions concerning the address of establishment are not striking without prejudicing the quality of results and therefore were selected as the main sector for the case study.

It is recommended for future research that models of trip generation are evaluated through surveys and interviews. It should be noted that research suggested requires support from government agencies to obtain a significant sample, which was not reached in this study. In this way, this study is exploratory. This support is necessary, given the difficulty of obtaining information about volumes of goods transported in Brazil, since information related to Urban Logistics are seen as strategic by the actors involved.

要約

本稿では二次資料を用いた貨物流動の推定手法について述べる。都市物流に関する問題は官民双方で日々重要性を増してきている。ブラジルでは交通渋滞や政策の欠如、意思決定に使用可能な情報の制限などに起因する効率の悪さは、共通の認識となっている。したがって本稿では、ブラジルでの都市物流における意思決定を補助するための、単純ではあるが効果的なデータ処理の方法論的アプローチを記述する。提案は国内で利用可能な共通データの収集と、それらのデータを異なるパラメータ・セットによって定まる検討地域に適用する手法からなる。ベロ・ホリゾンテ市中心部におけるケーススタディを通じて得られた結果は、系統的データ収集の必要性と、方法論の有効性を示している。とくに効率的な政策の立案においては、効率的で動的な情報のフィードバックが重要である。

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